3.2.3. The need to dial additional digits to make telephone calls

The need to dial extra digits to access an operator is a source of inconvenience to users. There is, in the first place, a need to learn (or programme into CPE) the access codes, and there is also the on-going hassle of dialling (and remembering to dial and sometimes mis-dialling) extra digits. A number of studies exist which estimate the importance of this in terms of the price discount customers require to compensate them for this inconvenience. Many of these have been conducted on behalf of operators and are, therefore, confidential. However, a study by Tardiff[17] is in the public domain.

The results in this paper are based on a sample of 250 Japanese telephone users who were asked to rank their preferences for a number of service packages characterised by different prices, suppliers, provisioning time, range of service, and number of additional digits to be dialled. Using this data, Tardiff undertook a statistical analysis based on a rank-ordered logit model. From this, he concluded that:

> *Dialling four extra digits is equivalent to a price disadvantage of about 4%.*

Tardiff also noted that:

> *...the magnitude of the price coefficient in Table 2 is similar to comparable market share models developed for American consumers. This outcome is consistent with the observation that American and Japanese toll price elasticities are similar.*

While UK toll elasticities may differ slightly from those in the US and Japan, it is likely that the impact of dialling four extra digits would be similar in the UK.

We have, therefore, assumed that the need to dial a 4 digit access code to use a particular long distance operator in the UK could be equivalent to a price disadvantage of around 4%. In practice few users would need to dial 4 extra digits. This is because PBXs would be programmed with access codes, small businesses may install smart boxes, and single line users will tend to use smart sockets or memory buttons. It is not obvious whether having to dial, say, 2 extra digits would be equivalent to a price increase of more, or less, than 2%. It may be that the act of dialling additional digits (irrespective of how many) is the major inconvenience. However, it may also be that 1 or 2 additional digits (that can be easily labelled on the handset) present no real barrier, whereas 4 random (and easily forgotten) digits do.

The comparative impact of easy and equal access on UK dialling requirements is analysed in Table 3.1. Under easy access, additional digits may be required (depending on the type of CPE) whenever a customer wishes to use an operator other than BT. Pre-selection with over-ride changes this so that extra digits are only required if an operator other than the

[17] Timothy Tardiff, *Effects of Presubscription and other Attributes of Long-distance Carrier Choice*, presented at the 1994 National Telecommunications Forecasting Conference in Boston, Massachusetts.

pre-selected operator is used. Therefore, compared with easy access, pre-selection with call-by-call over-ride saves dialled digits for calls to the pre-selected operator (if not BT), but increases the number of digits dialled (by the same amount) if BT is selected for a particular call. Calls to other operators are unaffected (additional digits are required under both easy and equal access). Thus, the impact of pre-selection with over-ride will be to save additional digits to the extent that the customer wishes to use a non-BT pre-selected operator more often than they wish to use BT. In an extreme case, if a customer never wished to over-ride their pre-selected non-BT operator, extra digits would be saved on all long distance and international calls.

With pure call-by-call selection, there is a need to dial extra digits whichever operator handles the call. On the face of it, therefore, customers would be worse off than in the case of easy access.[18] Hence, assuming rational behaviour, no customers would request it on the basis of dialling requirements alone (although there may be other reasons for customers wanting call-by-call selection - for example, the fact that it offers a relatively easy way of "trying out" new operators, particularly if there is no need for a second bill or registration).

Therefore, according to whether pre-selection or call-by-call selection is used, the number of digits dialled by the user may either go down, or up. In both cases, the change in the number of digits required depends on the type of terminal equipment involved (e.g. a basic telephone, a telephone with memory buttons, or a programmable PBX). The maximum number will be four (because we assume 4 digit access codes). However, since 7-8 million new memory button telephones are sold each year, and increasingly more memory buttons are available per telephone, it seems unlikely that many customers contemplating changing their long distance or international operator would have a telephone without memory buttons. Indeed, it is probably reasonable to assume that the remaining stock of telephones without memory buttons is very largely held by customers who make relatively few calls and are unlikely to consider moving to another operator either with or without equal access. Thus, it is possible to narrow down the number of additional digits that would need to be dialled to either one or, at most, two.

Furthermore, at least half of all indirect service customers are likely to have programmable PBXs or smart boxes or sockets which will insert appropriate (e.g. least cost route) access codes under either call-by-call selection or pre-selection. Therefore, these customers would be unaffected in either case (once the re-programming has been carried out).

[18] The only possible benefit would be to customers who relied on manually dialling extra digits for a competitive service provider but sometimes forgot. Under easy access their calls would default to a non-preferred option (BT) rather than failing altogether. We have assumed that the protection of discount (through not allowing the call to be completed) is broadly equivalent to the annoyance and wasted time as a result of the call failing. Thus call-by-call selection offers no net benefits over easy access in this respect.

Table 3.1
Dialling Requirements Under "Easy Access" and "Equal Access"

	Basic Telephone				Memory/Mercury Button Telephone				
	Preferred operator (if BT)	Preferred operator (if not BT)	Alternative operator (if BT)	Alternative operator (if not BT)	Preferred operator (if BT)	Preferred operator (if not BT)	Alternative operator (if BT)	Alternative operator (if not BT)	Equal access benefit relative to easy access
Easy access	none	4 digits	none	4 digits	none	< 4 digits	none	< 4 digits	
Pre-selection with over-ride	none	none	4 digits	4 digits	none	none	< 4 digits	< 4 digits	positive benefit (up to 4% of price)
Pre-selection with no over-ride	none	none	n/a	n/a	none	none	n/a	n/a	positive benefit but restricted choice
Call-by-call	4 digits	4 digits	4 digits	4 digits	< 4 digits	< 4 digits	< 4 digits	< 4 digits	loss due to extra digits

Note: Dialling for PBX customers would be unaffected, and smart box connections do not require additional digits for the preferred operator under either case.

Source: NERA analysis

Therefore, under pre-selection, the "average" reduction in the number of digits that has to be dialled to reach an alternative operator is likely to be close to one. For similar reasons the average increase in dialled digits for customers opting for call-by-call equal access will also be about one.

In conclusion, compared with easy access, call-by-call selection increases the average number of digits that users have to dial by about one. Very crudely, it could be argued that this is equivalent to a price increase of around 1% for those opting for this form of equal access. Pre-selection reduces the number of digits dialled by each user by an average of one and so, very crudely, is equivalent to a price reduction of about 1% for those opting for this form of equal access.

3.2.4. Unwillingness to "sign up" to an unfamiliar operator

Unwillingness to "sign up" to an unfamiliar operator can be a significant deterrent to customer migration. However, this problem would be somewhat reduced, if not eliminated, if users were allowed to experiment with new operators through call-by-call selection ("toe-dipping"). This would especially be the case if registration were made easier (or eliminated) by billing being carried out by the local operator. Therefore, it is reasonable to assume that options that include call-by-call selection would reduce the discount a new operator needs to offer to attract customers.

The only evidence on the magnitude of this effect comes from Hull. As we have seen, virtually any customer in Hull is able to use the Mercury network for appropriate calls, without the need for registration, by just dialling a two digit access code. The call will then be billed in the usual way. This situation has existed since the late 1980s.

Despite the need to dial two extra digits (which on the basis of the last section we estimate is equivalent to a price increase of about 2%), Mercury receives over half of the outgoing calls with a price discount of only 12%[19] (which is equivalent to 10% after adjusting for the impact of dialling the two extra digits). Our modelling suggests that, for this to be the case, the residual threshold discount (excluding the impact of extra dialling) must have been virtually eliminated (ie. reduced from 5% - see Section 3.5.2.2 - to almost zero)[20].

In the context of equal access in the rest of the UK, we understand that most competitive long distance and international operators would wish to do their own billing, and so would retain some form of registration procedure (although this would be made as simple as

[19] This is a weighted average of a 20% discount on evening 'b' rate calls, a 1% to 2% discount on premium rate calls, and a 10% discount on virtually all other types of calls.

[20] Loss of half of the market over a period of 6 years requires on average 11% of calls to migrate each year. The model described later in this chapter predicts that this would require a discount of around 10% over and above the threshold discount. Given that the actual discount is 12%, and that the need to dial 2 extra digits is equivalent to a threshold discount of 2%, this would seem to imply that the residual threshold discount has been eliminated.

possible)[21]. We would expect that this would result in a much lower reduction in the threshold discount. We assume, as our central case, that a reduction of only 1% would be achieved for customers requesting call-by-call selection under separate long distance carrier billing. In the cost-benefit analysis, however, we examine sensitivities to this assumption. The results of these sensitivities are contained in table 5.2.

3.2.5. Summary

Table 3.2 summarises conclusions on the most important source of Type I benefits for each equal access option. In the case of awareness of alternatives, the generator of benefits is the acceleration of migration and, hence, realisation of the potential benefits. For the other factors, it is the reduction in the threshold discount that generates the Type I benefits. It is assumed that, where both pre-selection (without over-ride) and call-by-call selection are available (Option 3), customer demand will split 44/56 in favour of pre-selection[22]. However, where both pre-selection (with over-ride) and call-by-call selection are available (Option 2), customer demand will fall heavily in favour of pre-selection, since the extra facility of over-ride means that call-by-call selection will offer no significant benefits that cannot be provided by pre-selection with over-ride.

3.2.6. Alternative Direct Service Operators: A Complication

The cost benefit analysis also needs to take account of the interaction between long distance operators and alternative (ie. non-BT) direct service operators. In addition to indirect access to long distance and international operators, many customers have or will have the possibility of taking service from an alternative direct service operator. For businesses, this may include services from cable operators, Mercury 2100, MFS, Colt, Ionica, Scottish Telecom or Torch Telecom. For residential customers, this may include cable companies or Ionica. These companies will aim to provide their customers with savings on all local and long distance services.

[21] The reason given for by competitive long distance and international operators for wishing to do their own billing and thus retain some form of registration essentially relates to the value placed by these operators on having direct contact with the final customer. Direct access by competing operators to the customer through billing and registration might not be considered as essential in Hull, where billing is conducted by a company which does not compete in the long-distance or international markets.

[22] A small survey of 185 customers conducted by BT indicated that 23% of respondents thought they would prefer call-by-call equal access and 29% would prefer some form of pre-selection (the remaining 47% thought they would prefer their current method of access). This suggests a split of 44/56 in favour of pre-selection when both forms are offered.

Table 3.2
Summary of Sources of Type I Benefits

	Option 1	Option 2		Option 3		Option 4
	Pre-selection with over-ride	Pre-selection with over-ride	Call-by-call	Pre-selection	Call-by-call	Call-by-call
Awareness of alternatives	migration rate increased by 30%	migration rate increased by 30%	-	migration rate increased by 30%	-	none
Avoid initial costs	none	none	none	none	none	none
Avoid additional digits	threshold discount reduced 1%	threshold discount reduced 1%	threshold discount increased 1%	threshold discount reduced 1%	threshold discount increased 1%	threshold discount increased 1%
Testing new operators	threshold discount reduced 1%	threshold discount reduced 1%	threshold discount reduced 1%	none	threshold discount reduced 1%	threshold discount reduced 1%
Net impact on threshold discount	reduced 2%	reduced 2%	no net effect	reduced 1%	no net effect	no net effect
Net impact of option on threshold discount	reduced 2%	reduced 2%		reduced 0.56%		no net effect
Overall impact on migration	+30%	+30%		+30%		none

Source: NERA analysis

Where a BT customer has a choice between an alternative direct service operator (ADSO), an indirect long distance operator (ILDO) in conjunction with BT local service, and staying with BT for all services, the preferred option will be chosen and there is no complication to the cost benefit analysis. Where, however, the ADSO rolls out its network after a customer has signed up with an ILDO, the customer could be worse off than if the ILDO had not existed. This is because ADSOs generally offer greater discounts relative to BT than do ILSOs (in conjunction with BT). However, the costs of migration from an ILDO to an ADSO may exceed the differential discount, thus preventing the consumer from benefitting from the ADSO's service. This will reduce both the number of ADSO customers and quality of the ADSO customer base (since lost customers are likely to have higher than average call bills if switching to an ILDO is worthwhile). This will have possible adverse implications for investment by ADSOs.

This situation will arise with both easy and equal access and the question, so far as this study is concerned, is what difference does equal access make? Potentially it will worsen the situation, given that it can be expected to speed up the migration to ILDOs.

However, the effect is likely to be relatively small for two reasons. Firstly, equal access will be rolled out over the country over a period of some years, starting in 1997. By that time, local networks built by cable companies and Ionica will already have a considerable geographical reach. Secondly, the discounts planned by Ionica and the cable companies over BT tariffs (sometimes up to 25%) will in most cases be substantial enough to provide a sufficient saving over ILDOs. Nonetheless, as will be seen in Section 3.5.2, our modelling methodology will capture the impact of "ILDO lock-in".

3.3. Type II Benefits

The introduction of equal access would remove a barrier to entry in UK telecommunications, increasing the ease with which subscribers could move between competing operators. This is likely to put increased pressure on both BT and new operators. Although BT's loss is just the long distance element of lost long distance and international calls, this is likely to exert pressure on costs company-wide.

Although it is generally assumed that the benefits of competition will be significant, there is little direct evidence on the size of these benefits, as it is often difficult to separate the impact of competition from the influence of other factors such as changes in ownership and regulation.

In Appendix C we summarise the available evidence on the benefits of competition, particularly as it relates to increases in efficiency and productivity, and in Chapter 5 we examine the impact on the cost benefit analysis of different assumptions about the benefits of competition. Our central assumption is that a 1% reduction in BT's market share will lead to 0.47% increase in total factor productivity. This figure was derived as follows. A number of studies (see Appendix C) have focused on the telecommunications industry and used regression techniques to identify the impact of liberalisation on total factor

productivity. These studies cover the US, Japan and a number of other industrialised countries including the UK. The two studies in the US do not separate out the impact of AT&T's divestiture from the effect of competition. We have therefore assumed that half the identified effect is attributable to competition. The remaining studies do separate out the impact of competition. In each case, the identified impact of competition on total factor productivity was divided by the loss in market share of the dominant operator(s) to derive a ratio of the productivity improvement to the loss in market share. Taking an unweighted average of the ratios for the different studies gives a figure of 0.48.

Although this figure is derived in a rather crude fashion it accords with the conclusions of a recent paper by Haskel and Szymanski which uses regression analysis to measure the separate impacts of changes in competition (measured by changes in market share), management, ownership, regulation and unionisation on productivity growth in privatised UK utilities (including telecommunications). Their findings suggest that "firms who face more competition are more productive", with a 1% reduction in the dominant firm's market share leading to a 0.47% increase in productivity. Given our estimate that BT will suffer a market share loss of 0.9% between 1995 and 2010 as a result of equal access, this implies an efficiency improvement of 0.4%.

NERA has also performed cross-checks on the plausibility this result. This was done by estimating the impact on BT's rate of return implied by this market share loss and by a range of price changes as a result of competition, and then calculating the cost reduction BT would need to make in order to maintain its rate of return given this lower market share and the reduction in prices. The resulting cost reductions are not inconsistent with the figures derived using the productivity change to market share loss ratio.

Table 3.3
Cost Reductions which Maintain BT's Rate of Return

Additional competitive impact on prices (%)	Cost reduction required to maintain BT's rate of return (%)
0.0	0.2
0.2	0.5
0.4	0.7
0.6	0.9
0.8	1.2
1.0	1.4

Source: NERA analysis

3.4. Other Effects

3.4.1. Additional effects relating to local network competition

Apart from any impact that equal access may have on the development of local network competition (through fewer customers migrating to new operators), new local loop operators have argued that there will be additional effects where equal access is mandated for new local network operators. These would include:

- customers may lose out if they chose their own long distance carrier rather than allowing local operators to arrange the best deals they can with the competing long distance carriers on a wholesale basis. However, since equal access will not be imposed on customers, new local network customers could still (by default) use the long distance carriers arranged by their local operators;

- local network operators would lose control of the size of the total bill for customers opting for equal access, and so new local network operators would not be able to offer new customers any particular level of saving or balance of tariff structure;

- although the local loop operator is no longer responsible to the customer for the long distance element of a call, it may continue to be blamed for poor service levels.

Generally, we do not believe these effects would have a significant impact on the cost-benefit analysis. Furthermore, they are difficult to quantify with any accuracy.

3.4.2. Mis-dialled Calls

Any method of equal access (but especially call-by-call selection) requires changes to dialling patterns and so will result in increases in the proportion of incorrectly dialled calls. This imposes additional costs on users (in terms of wasted time) and operators (in terms of holding-up switching equipment). The effect on users has already have taken into account in the valuation of the cost of dialling additional digits. The impact on BT's switching capacity is additional to this, and is discussed later in Chapter 4.

3.5. Modelling the UK telecommunications market: the base case

This section provides details of the methodology employed by NERA to model the UK telecommunications market for the base case of the cost-benefit analysis. The model contains two modules:

- a UK market forecast module;

- a dynamic operator choice module.

3.5.1. UK market forecast model: the base case

Individual base line forecasts within the UK market forecast module are produced for the following services:

- lines - residential;
- lines - business;
- local call minutes - residential;
- local call minutes - business;
- national call minutes - residential;
- national call minutes - business;
- international call minutes.

For each of these services, market forecasts are produced using a series of demand drivers. The drivers include the following:

- **demographic drivers.** Growth in residential lines is affected by the size of the remaining pool of untelephoned households. Household forecasts are based on OPCS projections;
- **macro-economic drivers.** Demand for residential services is influenced by personal disposable incomes, whilst, for business services, the key driver is GDP. International calls are also affected by world trade. The macro-economic forecasts that underpin our model are based on those published by the LBS;
- **real price changes.** It is assumed that rentals continue to increase by RPI+2 until 1997. We have then assumed that, after 1997, BT will rebalance to LRIC (Long Run Incremental Cost) over a period of three years. NERA estimates that this would require annual real increases of 1.3% and 9.4% for business and residential lines respectively over a three year period. In sensitivity analyses we double the rate of rebalancing of line rentals over these three years to allow for any under-estimation of incremental line costs. After the year 2000, it is assumed that line prices remain constant in real terms. Also considered is a sensitivity in which the RPI+2 restriction on line rentals is maintained after 1997.

  International call real prices are assumed to decline at an annual rate of 10.9% until the year 2005 (taken from the findings of our model of the international telephony market for the Oftel resale project). In sensitivity analyses we double this rate. Beyond 2005 super-normal profits will have been removed and so the rate of price

decline tails off. Finally, domestic call price reductions are calculated to be consistent with an overall price cap of -7.5% to 1997 and -5.0%[23] from 1997 to 2005, at which point the price cap is removed and domestic call price decreases tail off;

- system size growth. Growth in call minutes is affected by growth in the number of lines.

In addition to these drivers, an underlying trend is included in each forecast to capture technological and social changes leading to greater telephone usage. The trend is calculated for each service so as to match the growth estimated by the model to the actual outturn for 1993/94.

Resulting market forecasts are shown in Chart 3.1. The main conclusions are:

- residential line growth is restrained by market saturation (and rebalancing to LRIC between 1997 and 2000);
- call growth exceeds line growth (ie. there is growing usage per line);
- national call growth exceeds local call growth;
- international call growth exceeds national call growth.

3.5.2. Dynamic model of operator choice: the base case

The model segments customers into 55 groups:

- Residential;
- Single line business;
- 2-10 line business;
- 11-20 line business;
- 20+ line business;
- with each of the above split into 11 call bill per line bands.

In any one year, some customers will migrate between:

- BT;
- indirect service operators using BT access;
- direct service operators (other than BT).

[23] Even if the price cap is removed in 1997, or calls are removed from the basket, it is likely that call prices will show a similar trend.

Christmas calls. Again there will be considerable uncertainty over the impact of these campaigns (especially when they depend on the activities of competitors) and so operators will need to carry additional network capacity to meet grade of service requirements. This additional capacity requirement (much of which will stand idle until traffic surge) imposes additional investment costs on all operators with no pay-back in terms of overall traffic growth.

The use of optical fibre technology in long distance networks means that the additional investment in transmission equipment in order to provide this extra capacity may be small (especially for new operators), the impact of investment in switching equipment is likely to be much more marked.

4.6.3. Potential interactions of equal access

Mechanisms would need to be in place to ensure that the incidence of adverse interactions between equal access and other services are minimised. It is difficult to assess the cost of this, because it is not clear what the interactions would be or how acceptable they are. Possible services affected are:

- network services such as CLIR;
- call barring services.

It is believed that the impact is not likely to be much greater than for easy access, as indicated by the impact of 141 on PABX users and MCL services. (It could be argued that moving routing selection to BT's network from PABXs will enable a more coherent integration with other routing products. However customers are likely to want to retain control over many aspects, including call barring.)

A decision would need to be made on how to handle special calls, eg MCL's Freefone numbers (0500). However this is not expected to cause technical problems, beyond the complexity of designing the decode tree.

4.7. Total Costs

4.7.1. Equal Access with Pre-selection

On the basis of the analysis in Sections 4.4 to 4.6, the undiscounted costs of implementing equal access (in £M, summed over the period 1995 - 2004 inclusive) with pre-selection are shown in Table 4.11.

The proportion of customers in each customer segment who migrate will be determined by two factors:

- network rollouts;
- price savings available to that customer segment.

3.5.2.1. *Network rollouts*

Network rollouts place a restriction on the percentage of customers who can migrate in any one year. It is assumed that customers fall into one of three categories:

- those with a choice of:

  - BT;
  - one or more indirect access carrier (e.g. Mercury 2300, Energis, Sprint, AT&T);
  - one or more alternative direct access carrier (e.g. Mercury 2100, cable telephony, Ionica, MFS, Colt);

  The proportion of customers in this category will steadily rise over time as alternative local networks are rolled out (we assume an increase from 15% now to 75% by 2000[24]);

- those with a choice of:

  - BT;
  - one or more indirect access carrier (e.g. Mercury 2300, Energis, Sprint, AT&T).

  This proportion of customers is calculated as the residual after deducting the previous and following (BT only) proportions;

- those with no choice other than BT. We understand that easy access, or equal access, could be made available to about 95% of the UK population. The remaining 5% are located in areas where easy access is not available, or no indirect service provider has a point of presence within cost effective reach. It is assumed that this percentage necessarily remains with BT throughout the forecast period.

[24] By March 1994, cable passed about 15% of households. This is expected to rise to 65-70% once franchise builds are completed. Meanwhile, Ionica plans to be within reach of 75% of UK households by the year 2000.

3.5.2.2. *Price savings*

Of those customers who are in the "footprint" of alternative service providers, it is assumed that, in any one year, a percentage of the existing base will migrate to whichever alternative offers the lowest prices. This percentage will be related to the savings available. Therefore, the model required detailed call bill data, which we have received from BT. We then used the published tariffs and discount schemes for different categories of customer of a range of operators to estimate potential savings.

If the savings on total bill are below a certain threshold (currently of the order of 2½% to 5%[25], plus an annualised contribution towards any connection or registration fee for the new operator) there will be no migration. For direct access competitors, inclusion of a connection charge for some operators will result in an overall threshold discount of around 6%. For indirect service operators offering discounts on only long distance and international calls and with very low (or free) registration, the effective threshold discount on total bill is much smaller, at around 1½% for easy access, but lower for equal access (for reasons discussed later). As savings rise above this threshold, the percentage of customers who migrate in any one year also rises, as shown in Chart 3.2. The precise relationship between price differentials and the rate of annual migration is modelled by an inertia factor[26]. This factor has been calibrated to fit experience to date (mostly on take-up of Mercury's direct and indirect services, and cable telephony growth). It has also been validated against other available forecasts of take-up of new operators' services. These include forecasts of cable telephony growth by Goldman Sachs[27] and the CCA[28] (both forecasting in the region of 5 million lines by the year 2000), and Ionica's commitment to 1 million lines also by the year 2000, as well as NERA's estimates of other operators' lines, e.g. Mercury, MFS, Colt, Torch and Scottish Telecom).

If a customer, initially without the possibility of choosing a direct service operator, changes operator once (from BT to an indirect service provider), a further subsequent move to a newly built direct service operator is possible provided the further savings available exceed the threshold discount. If the savings do not exceed this amount, the customer remains with the indirect service operator (i.e. "TLDO lock-in as described in Section 3.2.6).

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[25] This is based on what we understand to be the consensus amongst operators in the presence of number portability, and results of surveys by OVUM. The threshold discount is calculated from each operator's billed revenue. Thus, if direct service operators need to achieve 5% discounts on a customers' total bill, indirect service operators, who offer just long distance and/or international calls, will only need to achieve 5% savings on the services they provide. This may be a little extreme, and it is possible that the percentage threshold discount required on long distance and international calls is actually higher in order to provide the same level of absolute saving to justify changing operator.

[26] This allows for the fact that potential beneficiaries (for whom price discounts exceed the threshold level) do not all migrate immediately.

[27] See New Media Markets, December 1994, page 12.

[28] *The Case for Cable*, The Cable Communications Association, January 1995.

We have assumed that the current savings offered by alternative long distance and international operators will reduce over time. The speed of this reduction has been forecast with reference to experience from the US. Chart 3.3 shows how the tariffs offered by AT&T and its competitors (for calls between New York and Los Angeles/San Francisco) changed over the ten year period in which these competitors established their 35% share of the US long distance market. Using this data we estimated a simple partial adjustment model[29]. This model estimates that, apart from an underlying price differential of only ½% which remains, in each year the size of the long distance call bill reduction offered by AT&T's competitors narrowed by 18% - resulting in a gradual convergence of prices. A similar pattern of reduction of price differentials has been assumed to occur in the UK over the next 10 years.

The speed at which the savings to customers from using other operators dwindle over time will determine the ultimate market penetration of competitors. For example, if in one customer group savings of 15% are currently available, a certain percentage of customers will migrate each year (say, for example, 10%). However, as the savings narrow over time, the rate of migration will slow until the savings fall below the threshold discount when migration stops altogether. If the new operator ever found itself in a position where its prices were above those of BT, plus the discount threshold, migration would be reversed.

Chart 3.4 shows the market share forecasts for direct access lines resulting from this methodology. The model predicts that BT's net loss of direct access lines stops beyond the year 2000 as the price saving falls below the threshold discount and most network builds are completed. Thus, the competitors' market share stabilises at around 15% to 20%. As will be seen, we have conducted a sensitivity in which the threshold discount is reduced, thus resulting in additional migration beyond the year 2000. Of the BT exchange lines, the model predicts that (without equal access) 1.5 million of these subscribers will use indirect services to other long distance operators.

3.6. Modelling the impact of equal access

The same model used to calculate the base run forecast can also be used to estimate the impact of equal access. Since equal access will not be implemented on any significant scale prior to 1997 (see next chapter), the existing requirement for equal access traffic to pay ADCs will have no impact up to that date. In addition, we have assumed that the current ADC regime will be abolished during 1997. As a result it is assumed that the new interconnection charges and any contributions by BT's competitors to USO costs will allow indirect service operators to maintain the same price differentials as in the base case.

[29] In a partial adjustment model, there is an expectation that a constant proportion (in this case estimated by an ordinary least squares regression analysis to be 18%) of the differential will be eroded each year.

Chart 3.2

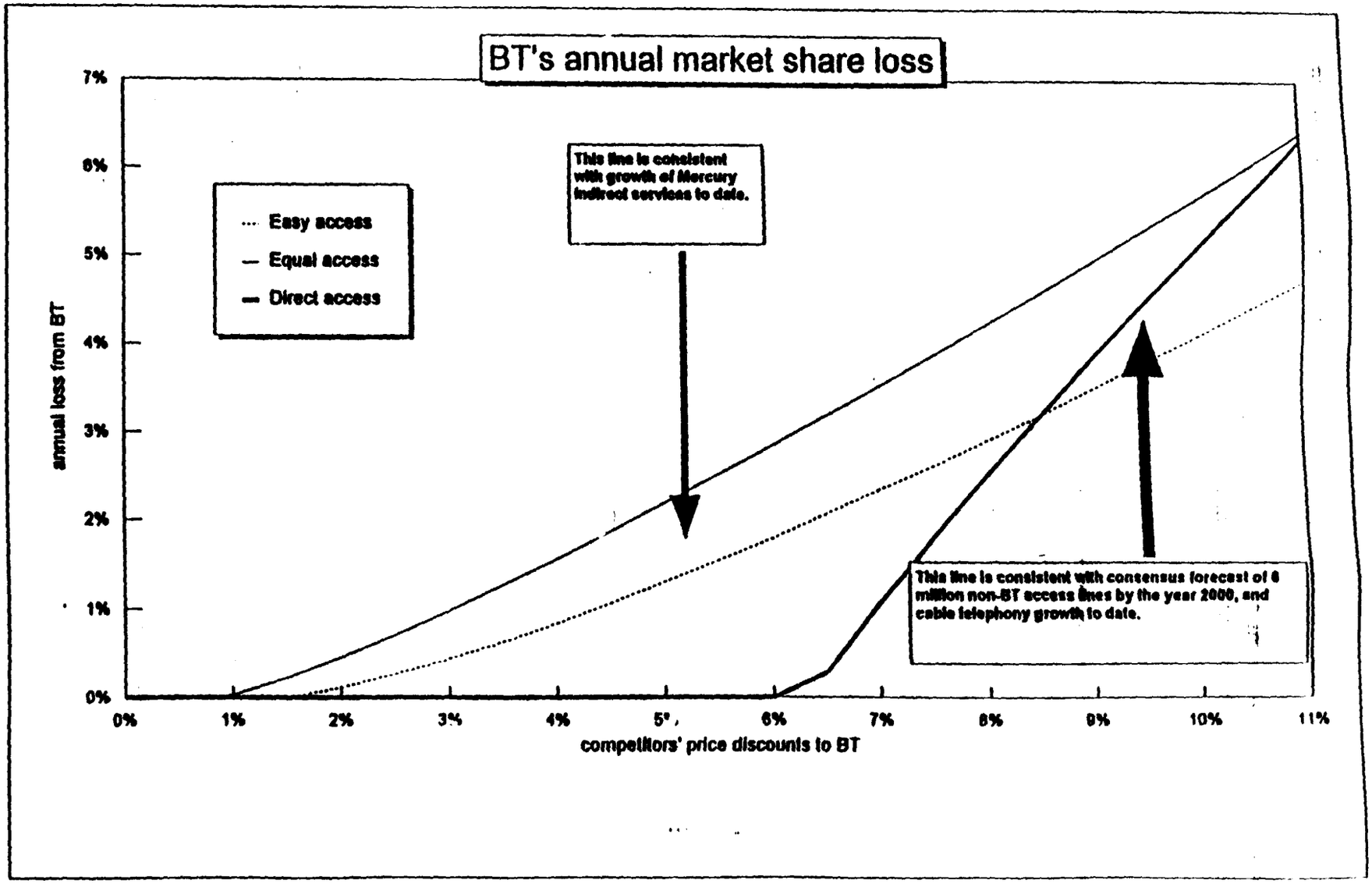
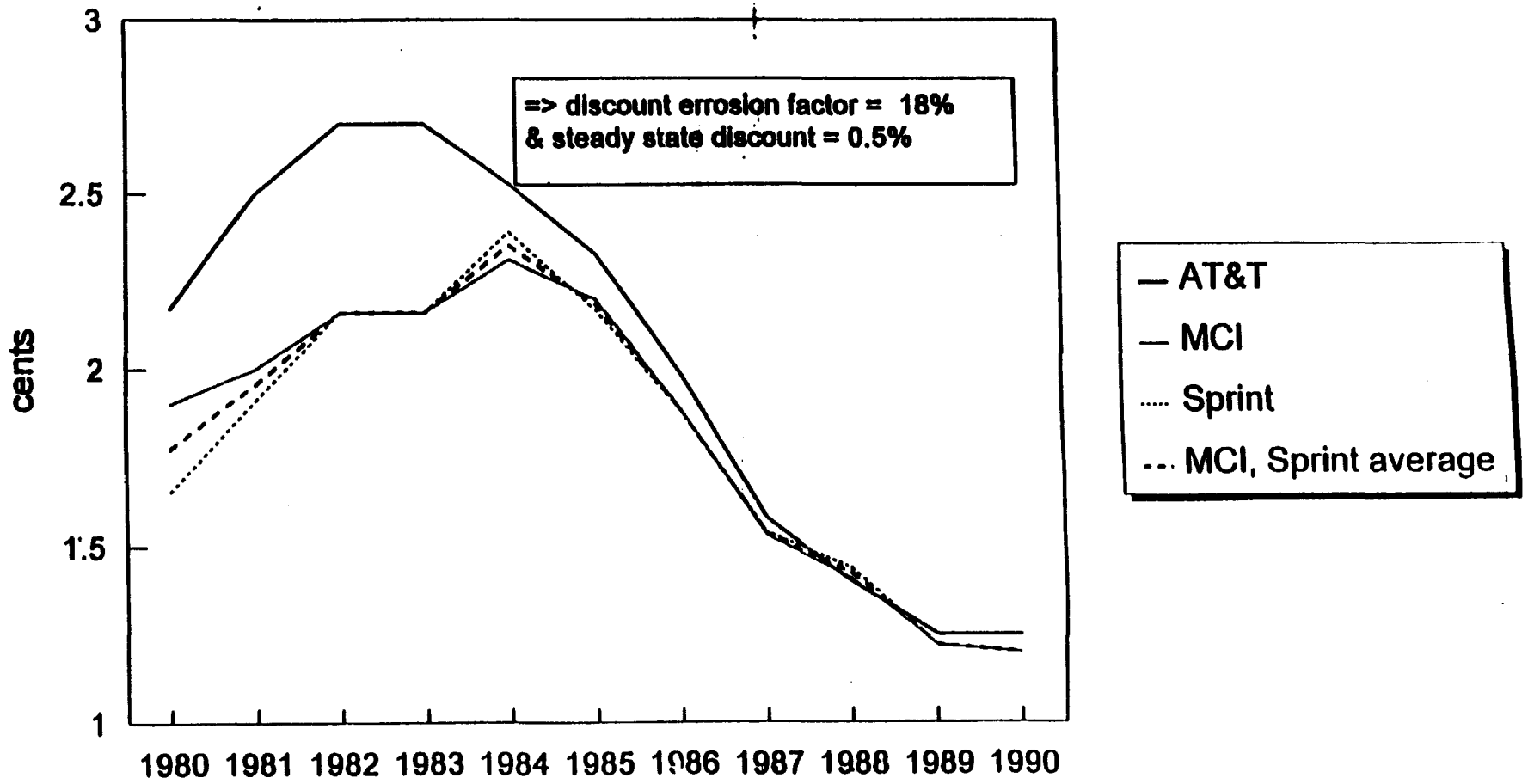

BT's annual market share loss
7%
6%
5%
4%
3%
2%
1%
0%
annual loss from BT
Easy access
Equal access
Direct access
This line is consistent with growth of Mercury indirect services to date.
This line is consistent with consensus forecast of 6 million non-BT access lines by the year 2000, and cable telephony growth to date.
0%
1%
2%
3%
4%
5%
6%
7%
8%
9%
10%
11%
competitors' price discounts to BT

Chart 3.3

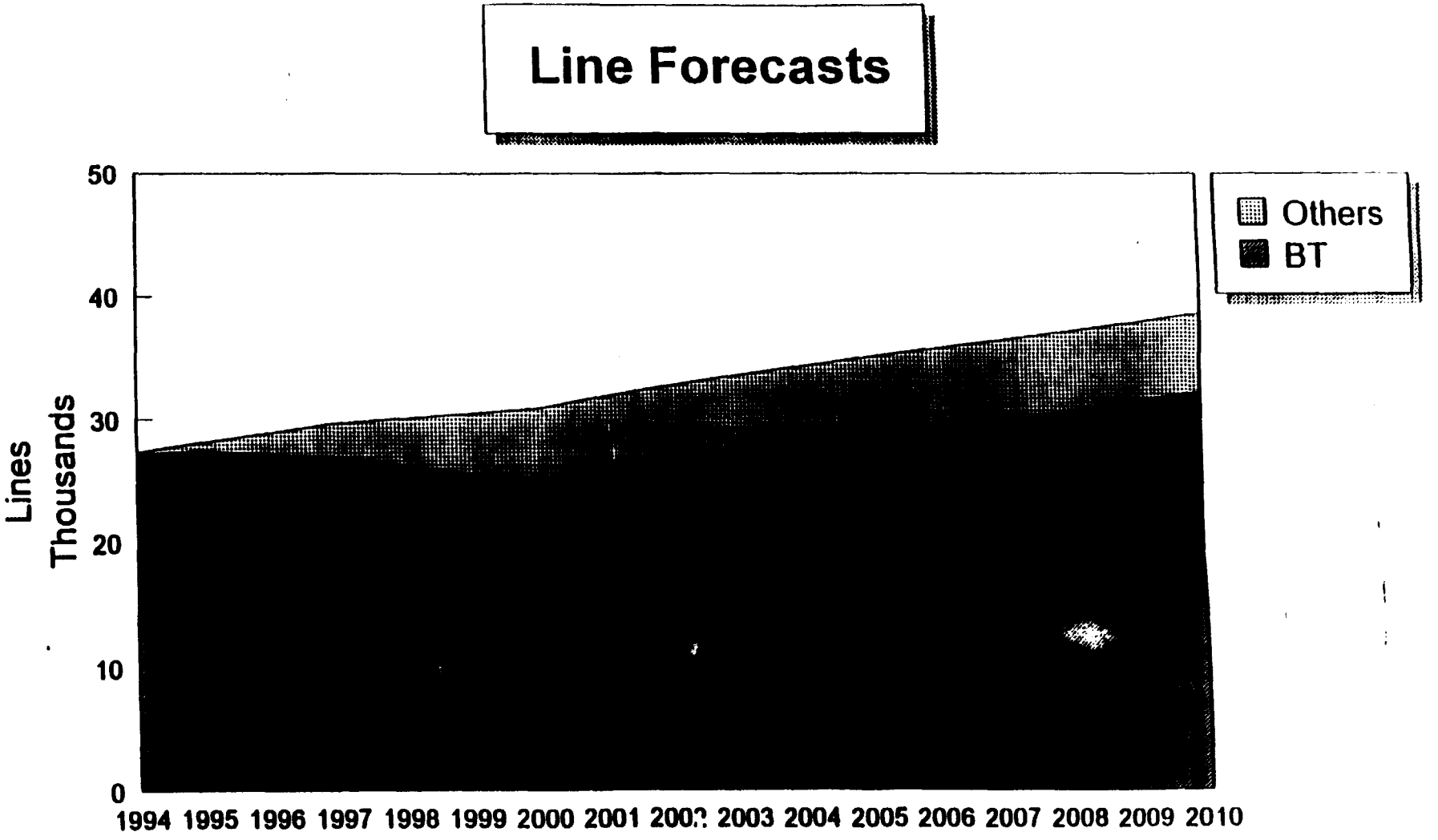
Convergence of US long distance tariffs

Price for 5 minute daytime call between New York and Los Angeles/San Fransisco



Source: FCC & NERA analysis

Chart 3.4


Line Forecasts
Lines
Thousands
50
40
30
20
10
0
1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010
Others
BT

However, equal access affects the attractiveness of indirect services and so will affect the migration of customers between networks. Our previous analysis concluded that the introduction and availability of equal access would reduce the threshold discount (via the reduction in the number of dialled digits and the enhanced ability to try out new operators) and would increase the speed of migration (as a result of heightened awareness of alternative operators). Table 3.3 reproduces the estimates of these effects which were derived in Section 3.2.

Table 3.3:
Summary of Market Impact of Equal Access

	Reduction in threshold discount	Impact on migration rate
Option 1	2%	increased by 30%
Option 2	2%	increased by 30%
Option 3	0.56%	increased by 30%
Option 4	0%	

Source: NERA analysis

The model described in this chapter can be used to estimate the market impact of these changes under each equal access option and hence derive the associated Type I and Type II benefits. The model predicts that, at most (Options 1 or 2) equal access will increase the number of BT lines using indirect services from other long distance operators by around 1 million, from 1.5 million to 2.5 million by the end of the period. The resulting estimates of Type I and Type II benefits are shown in Table 3.4 below.

Table 3.4
Summary of Results of Benefit Analysis: Base Run

	Discounted sums (1995 to 2005) (£millions)			
	Option 1	Option 2	Option 3	Option 4
Type I benefits	£20	£20	£7	zero
Type II benefits	£59	£59	£36	zero
Total benefits	£79	£79	£43	zero

	Discounted sums (1995 to 2010) (£millions)			
	Option 1	Option 2	Option 3	Option 4
Type I benefits	£35	£35	£12	zero
Type II benefits	£164	£164	£89	zero
Total benefits	£199	£199	£100	zero

Source: NERA analysis

Options 1 and 2 have the highest benefits since they combine pre-selection with call-by-call selection over-ride. Note that the addition of call-by-call selection alongside pre selection with call-by-call over-ride offers no additional benefits (ie. Option 2 has the same benefits as Option 1). Option 3 suffers from "locking-in" those customers who opt for pre-selection (so that they are unable to test out other operators). In the case of Option 4, the benefits of testing out other operators are effectively cancelled out by the need to dial additional digits for some customers.

Table 3.4 also shows that the benefits are considerably higher if the period from 2005 to 2010 is included in the analysis, since the increased migration to new operators has had more time to take effect.

4. COSTS OF EQUAL ACCESS

4.1. Introduction

This chapter analyses the main cost impacts of imposing equal access and, summarises the technical options for its introduction.

The costs included in this analysis are incremental and make no allowance for:

- consequent changes which operators deem necessary in business support costs, marketing strategy etc;
- contractor mark-up for work undertaken in the event of BT being forced to make changes to its network.

4.2. The Network Structure

4.2.1. Current system

The relevant components of the UK's telecommunications system are:

- user equipment - telephones and PABXs, configured to a standard connection. PABXs contain subscriber preferences and settings, and are often programmed to perform digit translations;
- line terminations, wall sockets and smart boxes, providing the point of user connection together with (in some cases) remote network functionality;
- local lines: single analogue exchange lines, ISDN lines and multiple lines (DASS),
- local exchanges (LEs), to which subscribers are connected (mainly BT and cable communications operators). Local exchanges contain databases indicating the status and service profile of each connected customer;
- trunk links, based on CCITT Signalling System number 7;
- trunk exchanges (mainly BT, Mercury and now Energis). BT refers to these as Digital Main Switching Units (DMSUs);
- links between operators, almost all between BT's DMSUs and other operators' trunk exchanges;
- international exchanges, connected to trunk nodes.

In addition each operator has a central information system which monitors and controls its network configuration.

A simplified picture of the overall system is shown in Figure 4.1.

4.2.2. BT's Network

BT's local exchange base includes four main types of exchange:

- System X, serving some 17m subscribers;
- AXE10, serving some 5m subscribers;
- TXE4 (semi-digital), serving some 5m subscribers;
- UXD5, serving just 0.1m subscribers.

System X and AXE10 switches have, on average, around 30000 connected subscriber lines. TXEs average 12500 lines, while UXDs average 250 lines.

A further 0.2m subscribers are still on analogue exchanges, but these are scheduled for replacement in the next few months and are excluded from this analysis.

4.2.3. Back office systems

Supporting the management of this network are a variety of information systems. The largest and most complex is BT's customer service system (CSS), which provides a single logical database for all domestic BT customers. Changes made on CSS are downloaded to exchanges from time to time. Other operators have similar arrangements.

4.2.4. Easy access

Indirect access services offered by BT at the moment are of two types:

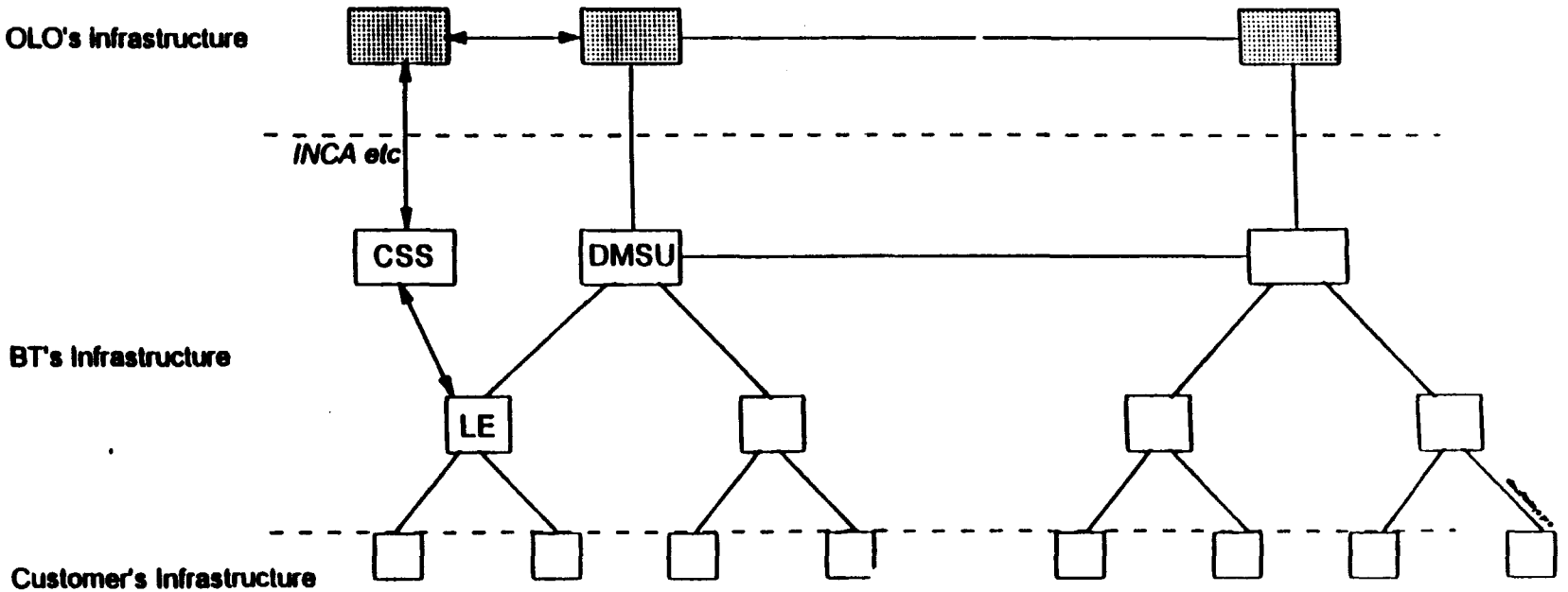
- two stage calls, in which the subscriber dials a 3 digit access code to be routed to the selected operator (C7 signalling) and then dials a PIN (MF4 signalling) to identify and authenticate himself to the other operator;

- single stage calls, in which the subscriber dials a four digit access code and BT passes the calling line identity (CLI) to the OLO (other licensed operator) for authentication. In this case the PIN is unnecessary.

Single stage calls are set to be available on more exchanges by the end of the summer 1995.

Subject to the capability of the subscriber's DLE, the choice of which easy access product to use is made by the OLO.

Figure 4.1
UK's Telecommunications system



It had been thought that single stage calls would be preferred where available since they require less input from the user; however the (limited) capacity for roaming using two stage calls, together with the ease of making two stage calls using "smart" end systems (like MCL's blue button, Energis' smart box, or PABX number conversion features) has meant that two stage calls remain popular.

Indirect access is offered to OLOs subject to agreements on maximum echo and delay on calls. Very indirect calls (eg Inverness to Aberdeen using an OLO whose only point of interconnect with BT is in London) are therefore likely to be failed. This will remain the case if equal access is introduced.

4.3. Implementation of Equal Access

4.3.1. Nature of Equal Access

Equal access, as defined for this study, differs from easy access in the following key ways:

- the option of pre-selection of any long distance operator must be available to any customer;
- non-local calls to be carried by BT must also have a prefix (unless BT is the preselected operator).

It is also the case that long distance operator access codes must be the same length for all operators, probably four digits. This represents no significant technical change relative to easy access (except for MCL compatible equipment which is based on three digit codes).

In this study we are considering a base case, and four options for equal access:

- Option 0: OLO customers are offered easy access, based on the current BT service offerings;
- Option 1: customers can subscribe to a service in which long distance calls are routed through a nominated OLO except where a prefix is dialled ("overrideable preselect").
- Option 2: customers have the choice of subscribing to (i) an equal access service in which each long distance call is individually prefixed ("call-by-call"), or (ii) an overrideable preselect service.
- Option 3: customers have the choice of subscribing to (i) a call-by-call service, or (ii) a service in which all long distance calls are routed through a nominated OLO ("fixed preselect").
- Option 4: customers can subscribe to a call-by-call service.

4.3.2. Practicalities

Changes to BT's network

In order to put equal access in place the following network changes would be needed:

- in local exchanges, each customer would need to have space to mark his long line operator preference (if he chose to have one);
- in local exchanges, the routing table would need to be reprogrammed to understand and correctly route numbers dialled with the relevant long line operator prefixes.

These changes would be needed in any of the equal access service options that contain the possibility of a preselected long distance operator.

It is BT's view that there is unlikely to be a technical problem (eg. insufficient memory or processing power available within the switches) for System X exchanges, but that the AXE10s are likely to prove more difficult to configure because:

- the memory structure in AXE10s is more tightly constrained (and is configured on a switch by switch basis);
- the 16-bit routing bus structure potentially limits the scope for constructing suitable decode trees.

Problems might be caused in both System X and AXE10 exchanges if:

- the equal access service had to allow for separate pre-selection of long distance national and international operators;
- it had to support the pre-selection of more than one national long distance operator, eg by charge group.

The existing customer data field structure allows a single byte for customer status characteristics, of which half the states are already used. Customers can therefore be offered up to around 100 *combinations* of preferences[30].

Further, while a single pre-selection can be accommodated by relatively minor changes in switch processing power, the decision support required by the routing algorithm in an

[30] This assumes that preferences replace any other customer status flag. If there is a requirement to log pre-selections independently of other customer status flags, the number of preferences that can be offered will be reduced drastically (e.g. in the case of KC it may be reduced to about four).